Impact of changes in rivers inputs during the last decades on the biogeochemistry of the eastern Mediterranean basin

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The Mediterranean Sea (MS) is a semi-enclosed sea characterized by a zonal west-east gradient of oligotrophy, where microbial growth is controlled by phosphate availability in most situations. External inputs of nutrients including Gibraltar inputs, river inputs and atmospheric deposition are therefore of major importance for the biogeochemistry of the MS. The latter has long been considered to be driven mainly by nutrient exchanges at Gibraltar. However, recent studies indicate that river inputs significantly affect nutrients concentrations in the Mediterranean Sea, although their resulting impact on its biogeochemistry remains poorly understood. In this study, our aim was to help fill this knowledge gap by addressing the large-scale and long-term impact of variations in river inputs on the biogeochemistry of the Mediterranean Sea over the last decades, using a coupled physical- biogeochemical 3D model (NEMO-MED12/Eco3M-Med). As a first result, it has been shown by the model that the strong diminution (60%) of phosphate (PO4) in river inputs into the Mediterranean Sea since the end of the 1980s induced a significant lowering of PO4 availability in the sub-surface layer of the Eastern Mediterranean Basin (EMB). One of the main consequences of PO4 diminution is the rise, never previously documented, of dissolved organic carbon (DOC) concentrations in the surface layer (by 20% on average over the EMB). Another main result concerns the gradual deepening of the top of the phosphacline during the period studied, thus generating a shift between the top of the nitracline and the top of the phosphacline in the EMB. This shift has already been observed in situ and documented in literature, but we propose here a new explanation for its occurrence in the EMB. The last main result is the evidence of the decline in abundance and the reduction of size of copepods calculated by the model over the years 1985–2010, that could partially explain the reduction in size of anchovy and sardine recently recorded in the MS. In this study, it is shown for the first time that the variations in river inputs that occurred in the last decades may have significantly altered the biogeochemical cycles of two key elements (P and C), in particular in the EMB.